

technic" a higher department, providing for the more specialized wants of each locality. This will be a work which no body is so well fitted to undertake as the great Institute which has been a pioneer in higher technical instruction. Such, it appears to us, is the true solution of the question of the relations between the Charity Commissioners' scheme and the City and Guilds of London.

One word of caution in conclusion. The new institutes should be allowed to grow, and not be started on too ambitious a scale at first. Local wants change, and the institutes should develop in harmony with their changes. This is the lesson of the old Mechanics' Institutes and Athenæums. The lesson is repeated in the newer experiments of Mr. Hogg's Polytechnic, and the People's Palace. We do not want to begin with erecting huge shells of bricks and mortar, hoping that life will somehow come into them after a time. The life first, then the buildings, to grow as it expands and deepens—that surely is the law of nature. "Several architectural white elephants" is the dismal but suggestive forecast of a writer in the *Charity Organization Review*, on the supposition that this law is violated. If these warnings are neglected, the promoters of the movement will be merely courting failure, however good their intentions may be. And they will have failed because "they were not poets enough to understand that life develops from within."

ASSAYING.

Text-book of Assaying. By C. Beringer and J. J. Beringer. (London: Griffin and Co., 1889.)

THIS text-book marks an important departure in the literature of assaying. The authors abandon the dreary details of traditional methods, and attempt with success to rationalize the art of the assayer, rather than to follow the usual course of reproducing "dry" assay methods and elaborate classifications of processes the interest of which is only historical. Assaying is here treated, in a broad sense, as the determination, by analytical methods, of components of ores and of intermediate or finished metallurgical products. Such compounds may be either of value in themselves, or important from being valuable or injurious in the operations of smelting, or in adapting the metals for use.

The methods of the authors, and the measure of success which they have attained, may be fairly judged by their treatment of copper, lead, and iron. Copper ores and furnace materials are still sold in the English market by the "Cornish" assay. This antiquated method of assaying has really no claim to retention, now that more trustworthy methods are well known, and the authors give it but little prominence. They, however, repeat the fallacious argument of its apologists by stating that "it gives the purchaser an idea of the quantity and quality of the metal that can be got by smelting." The Cornish assay does not deserve even this modified approval, as the results it affords neither represent the actual amount of copper contained in the ore, nor the proportion of metal which can be produced by smelting, and several expert assayers, working on portions of the same samples, will obtain results which vary in the most erratic way. Fortunately for those who may be guided by this text-book, its authors proceed to describe assaying processes which are really

well calculated to give trustworthy indications as to the quantity and quality of metal obtainable from ores. These are to be found in well proved "wet" methods of determining actual copper contained in ores as well as the components that interfere with the extraction and the quality of the metal. In describing these methods, ample information is given for the guidance of the smelter under the varying conditions of the metal's occurrence. While passing shortly over the Cornish assay, the authors judiciously omit such clumsy "wet" methods of assay as the direct titration by cyanide of potassium, which is retained in some recent books of standing, although it has been abandoned by most skilful assayers. On the other hand, titration by cyanide of potassium after separation of the copper from interfering metals, and the assay by electrolysis, leave little to be desired in rapidity and accuracy, and to these due prominence is given. Failing reasonable manipulative skill, no assay can be accurate, and the expertness demanded by those who conduct the "dry" or Cornish assay is not more easily acquired than is the analytical skill needed for better "wet" methods. In an assay method giving accurately the amount of metal actually present in the ore, the metallurgist has a sure basis for calculation, the results of which can be brought under the control of his experience as to the losses of metal in operations on a large scale. The results of the Cornish assay, with all its inherent uncertainty, have equally to be judged in the light of the smelter's experience as to what the final "out-turn" will be. In lead, again, the dry assay is usually treated in books on assaying with much elaboration, which is no longer useful, if it ever was. It gives results that indicate neither the actual amount of metal contained in the ore, nor the amount which will be produced by smelting, and like the Cornish assay for copper is most unsatisfactory for guidance in smelting. The wet methods of lead assaying which are described are convenient and trustworthy, while the only practically useful methods of dry lead assay are given in sufficient detail. In the assay of iron ores we find dry methods entirely omitted. The wisdom of this cannot be doubted, for the want of exactitude which is characteristic of the dry assay of copper and lead is still more marked in the dry assay of iron. Processes of wet assay capable of giving prompt and strictly accurate results are available, and these are fully described.

The plan of subordinating or ignoring unsatisfactory methods of assay, while giving prominence to those which have proved to be trustworthy, runs through the treatment of methods of assaying the other metals, as well as estimating the components of ores which are not usually dealt with in books on assaying. Among the latter are silica, the earths, sulphur, arsenic, and phosphorus. These demand study by the metallurgist, to whom, under either the necessity of "fluxing" them away, or of minimizing their interference with the purity of the metals, their ready and accurate determination is a matter of the greatest importance. The details of assaying the precious metals, though hardly sufficient for adoption in the assay of bullion in a mint, are all that is needed in a works.

The authors have clearly not been content to merely record published processes, but in order to add to the completeness of their work have given unpublished

results of the experience acquired by themselves and others. The writer notices their description of a process for the estimation of arsenic in minerals and metals, which was devised by himself for use in works under his control, that has not hitherto been published. It consists in the separation of arsenic from its associations, by distillation with ferric chloride mixed with calcium chloride, and subsequent titration of the distillate by iodine. The authors are mistaken in stating that there is a difficulty in obtaining ferric chloride free from arsenic. Even if there were difficulties, it is obvious that the process itself affords a ready means of eliminating arsenic from the ferric chloride mixture, before using it in the actual assay. In this and one or two other cases, there is a tendency to adopt the always undesirable method of "blank" experiments to correct error arising from the use of impure reagents, rather than whenever practicable to avoid the source of danger by the use of pure materials. These are, however, hardly noticeable blemishes in a really meritorious work, that may safely be depended upon by those using it either for systematic instruction or for reference.

THOMAS GIBB.

BREWING MICROSCOPY.

The Microscope in the Brewery and Malt House. By Chas. Geo. Mathews, F.C.S., F.I.C., &c., and Francis Edw. Lott, F.I.C., A.R.S.M., &c. (London and Derby: Bemrose and Sons, 1889.)

THERE are certainly few industries the growth and development of which have been more influenced by the progress of pure scientific discovery than those of the brewer and distiller. These industries, formerly carried on upon purely empirical lines, handed down from father to son through countless generations, have in recent years, through the advances in chemical and biological science, been so transformed that their successful conduct at the present time requires a most thorough acquaintance with the leading principles of these sciences. As a consequence of this change, we find an increasing tendency for these industries to become concentrated in a smaller number of hands each producing on a larger and larger scale. The small brewer himself lacking the necessary scientific training, and not able to afford the requisite skilled assistance, gives way before the larger breweries employing a complete scientific staff and provided with the latest improvements.

The present work is, we understand, intended to bring before those connected with brewing a concise account of the assistance which may be derived in the conduct of their business from the use of the microscope. We are of opinion that the authors have been unfortunate already in the choice of their title, as one of the most conspicuous results of modern scientific research in this direction is that the use of the microscope alone is of comparatively little value in the study of micro-organisms in general, whether connected with fermentation or other processes. This inadequacy of microscopic study *per se* the authors in various parts of their work indeed frankly admit. Modern students of these low forms of life have, in fact, become

more and more aware of the fallacious results yielded by mere microscopical observation when unaccompanied and uncontrolled by those processes of cultivation which have been developed during the past ten years. Even the work performed under the auspices of the masterly genius and supreme experimental skill of Pasteur has had to be revised and brought up to date by Hansen, with the aid of the more recent methods of research. Now, although the authors appear fully aware of the great change which has taken place since the earlier work of Pasteur, Reess, Fitz, and others, they have not sufficiently distinguished between observations which rest upon the surest foundation and fulfilling the most modern requirements, and those which, though possibly correct, require repetition and confirmation.

The absence of sharp differentiation in this matter cannot fail, we believe, to occasion much confusion in the mind of the ordinary practical student who depends upon text-books and manuals for his guidance and information, and it is, in our opinion, quite unnecessary that he should be burdened with the microscopic descriptions of the various forms of yeast given by the older observers, who were almost certainly dealing with impure cultures, but on the contrary he should rather devote his whole attention to the characters of such undoubtedly pure forms of yeast as have been obtained by the most recent methods. Moreover, unless the necessity of resorting to these cultivation experiments for obtaining accurate information is duly impressed upon the student, he will naturally be inclined to shirk these far more laborious and difficult observations, and place undue reliance upon microscopic features.

These remarks apply, perhaps, with even greater force to the manner in which the authors have dealt with the schizomycetes; in this part of the book we find much space devoted to microscopic descriptions of bacteria of uncertain purity, whilst there is little or nothing said about the methods by which these organisms can be really identified, and their characters defined. We also miss any adequate account of the staining-processes which are so invaluable in obtaining a correct idea of the microscopic forms and dimensions of bacteria. As an instance of the unsatisfactory present condition of brewing microscopy, we may quote the following sentence: "*Bact. lactis*, as seen in beers, is generally in the form of small rods, 2 to 3 μ in length, and sometimes in threads containing from 2 to 5 individuals; it is not certain, however, that this form is *B. lactis*." Thus, in respect of the bacterium which is perhaps of most consequence to the brewer, as being "the most commonly occurring disease-organism encountered in the brewing process" there is this absolute lack of all precise information.

What may be called the more purely scientific part of the work is succeeded by a chapter of "general remarks on the brewing process," which, embodying as it does some of the practical experience of the authors themselves, we would have gladly seen enlarged.

The book, which is printed on excellent paper and elegantly got up, is illustrated with a number of admirably executed plates, many of the best of which are original.

A full index and glossary are appended.